Space Weather Technical Forecast

Issued on Saturday, 21 October 2023 at 01:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Weak CME arrivals possible, with a chance of G1/Minor Storm intervals on Day 1 (21 Oct), declining thereafter.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity as recorded at GOES16 has been Low over the past 24 hours, with only low level C-class flares. There are currently six sunspot regions on the visible disc, all of which are relatively small and simple, with only AR3469 in the northwest showing some minor growth in recent hours.
No Earth directed CMEs have been seen in coronagraph imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, shows signs of very minor enhancement, possibly some glancing CME influence starting around 20/1230 . The wind speed has been at background levels throughout, varying between 330-380 km/s. The density rose through the first half of the period, becoming above average with a peak of 22ppcc, before declining to average through the second half of the period. The IMF was weak at first, reaching moderate levels from around 20/1230 UTC. The Bz was weakly variable, but gradually became moderately southward directed from 20/1610 UTC. The phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels.
GOES16 high energy (greater than 2MeV) electron flux was mostly at background levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a steady trend. The observation at 21/0000UTC was 1.9e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low solar activity is likely to continue. There is just a slight chance of M-flares, more so later in the period if we see new regions rotating onto the disc.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast is complex and carries high uncertainty, but overall the forecast is for relatively low activity. There are now two possible Earth directed CMEs. The first is expected to largely miss, but with the potential for a glancing impact in the next 24 hours. The other CME also has a slight chance of glancing impacts shortly afterwards. There is potential for some minor High Speed Stream (HSS) enhancement from CH62/- on Day 1 and CH63/- on Day 2 into Day 3 (22-23 Oct).
Geomagnetic activity is likely to be Quiet (Kp 0-2) for much of the time, but with spells of Unsettled to Active (Kp 3-4) activity, and a chance of G1/Minor Storm (Kp 5) intervals should any significant CME interaction occur.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to persist at background levels.
High energy electron flux (greater than 2MeV) is expected to be at background levels, perhaps rising to moderate depending on the strength of any CME or HSS enhancements. The associated 24-hour electron fluence is expected to remain below Active (1e8 integrated pfu).

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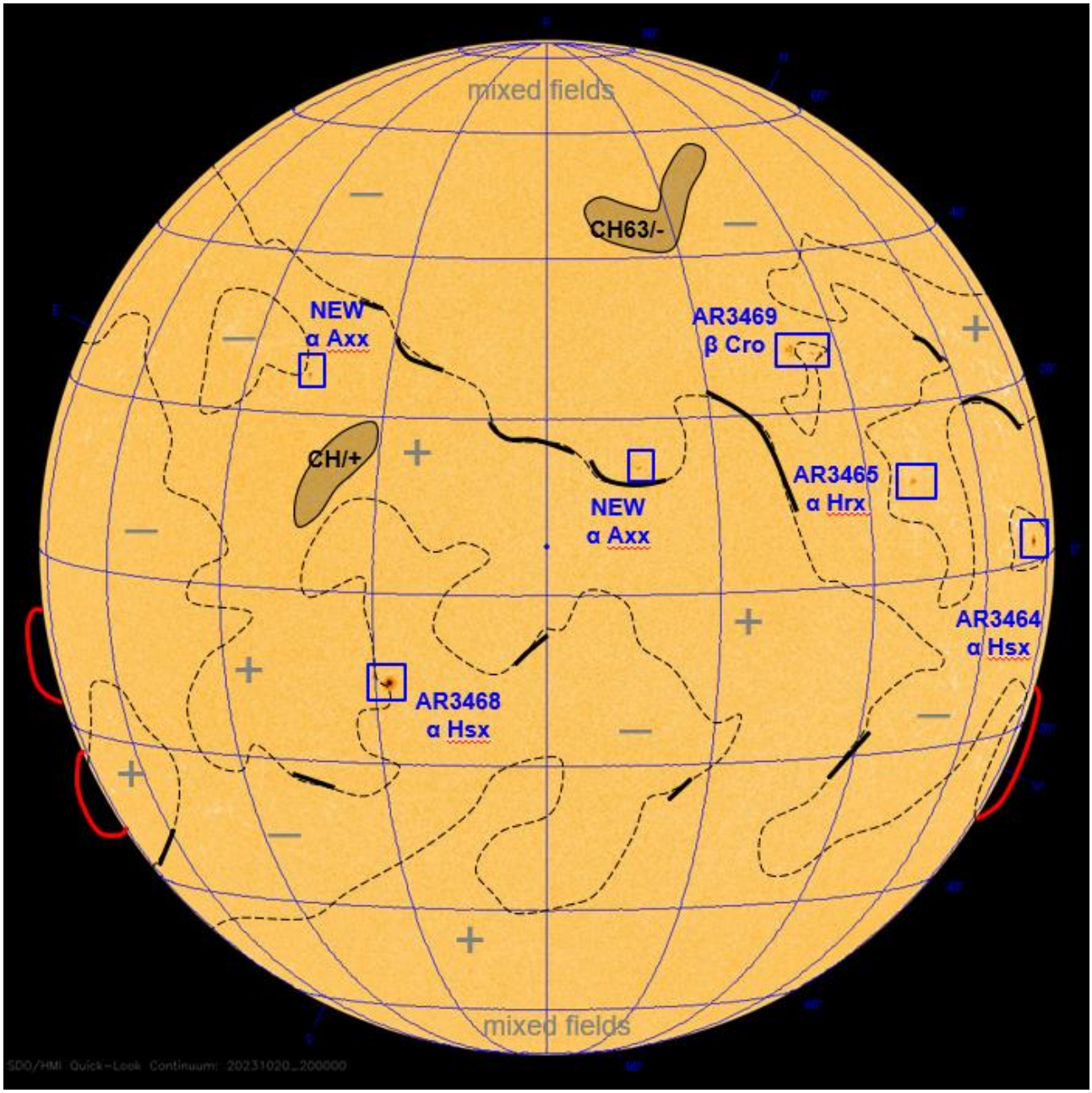
Figure 1. Solar Analysis Valid 20/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The geomagnetic forecast is complex and carries high uncertainty, but overall the forecast is for relatively low activity. There now two possibly Earth directed CMEs. The first was observed from a filament eruption near ex-AR3463 off the southwest disc early on 17 October. This is expected to largely miss, passing ahead and south of Earth, but with the potential for a glancing impact in the next 24 hours. The other CME was observed from the southeast around 18/0530UTC. This has been assessed as passing to the south and behind Earth shortly afterwards, also with a slight chance of glancing impacts. These two features could combine together.

There is potential for some minor High Speed Stream (HSS) enhancement from CH62/- on Day 1 and CH63/- later on Day 2 into Day 3 (22-23 Oct). Both are negative polarity, which means they are not favoured for strong geomagnetic connection at this time of year.

Geomagnetic activity is likely to be Quiet (Kp 0-2) for much of the time, but with spells of Unsettled to Active (Kp 3-4) activity, and a chance of G1/Minor Storm (Kp 5) intervals on Day 1 should any significant CME interaction occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/1430	Partial	Filament	SW	420 km/s	Early 21st	Very low confidence. Likely miss.
18/1132	Partial	Filament	SE	610 km/s	Late 21st or early 22nd	Very low confidence. Likely miss.

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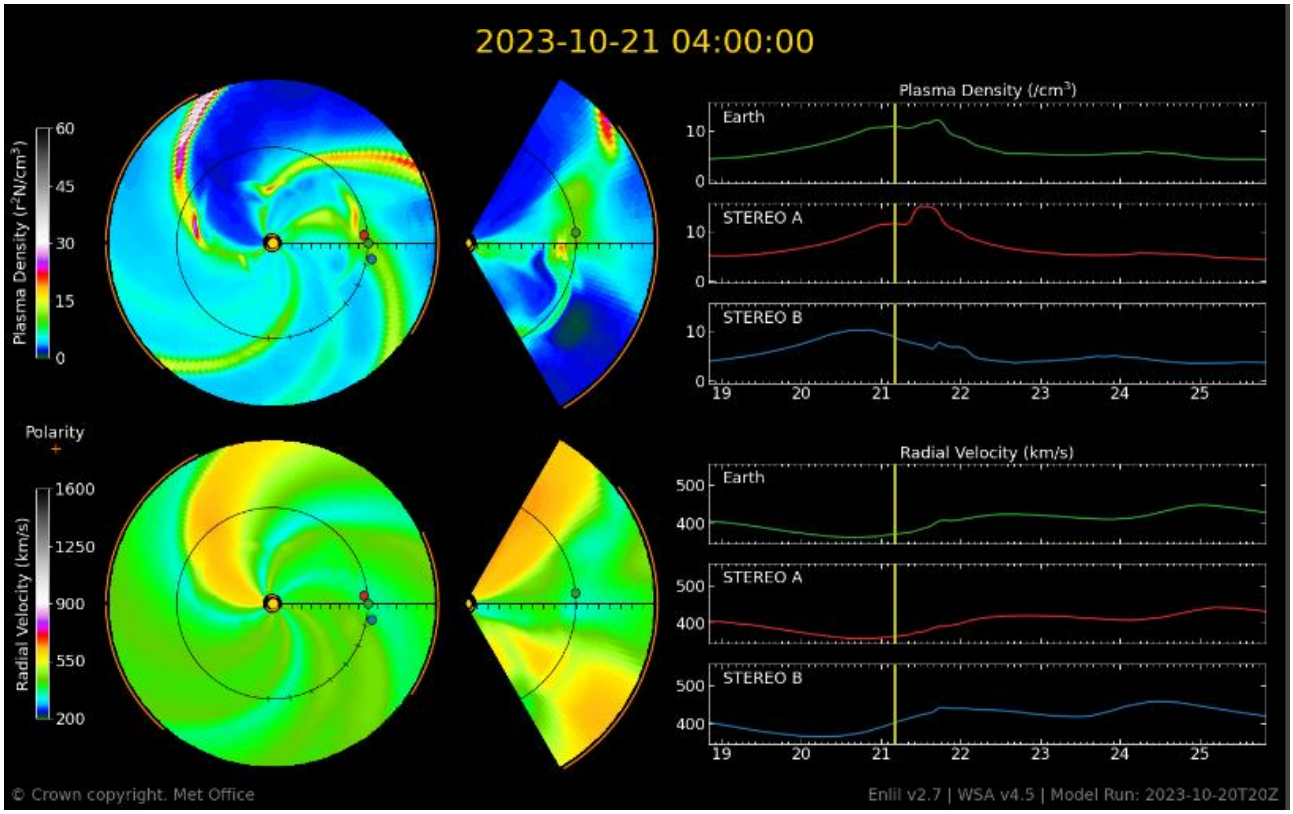
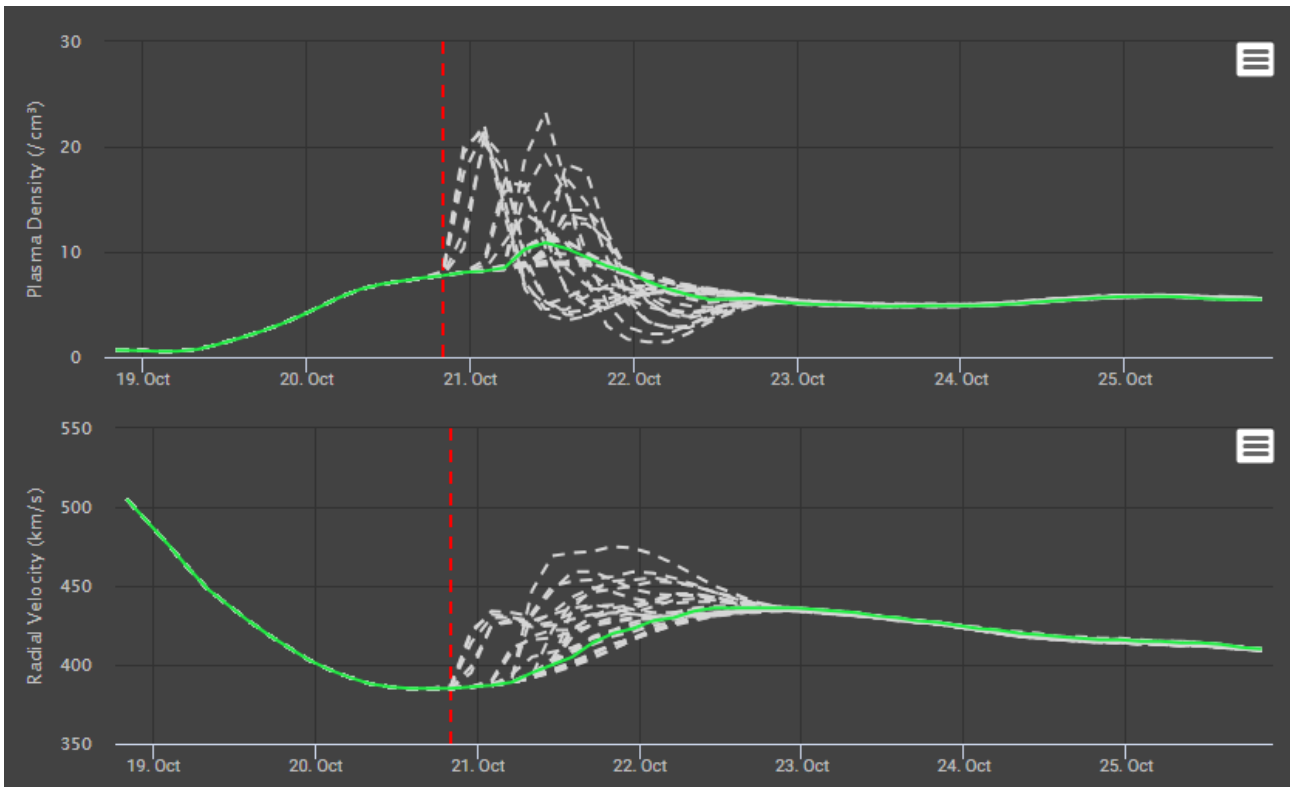
Figure 2: MOSWOC Enlil and ensemble, showing possible CME glancing blows during the next 24-36 hours.





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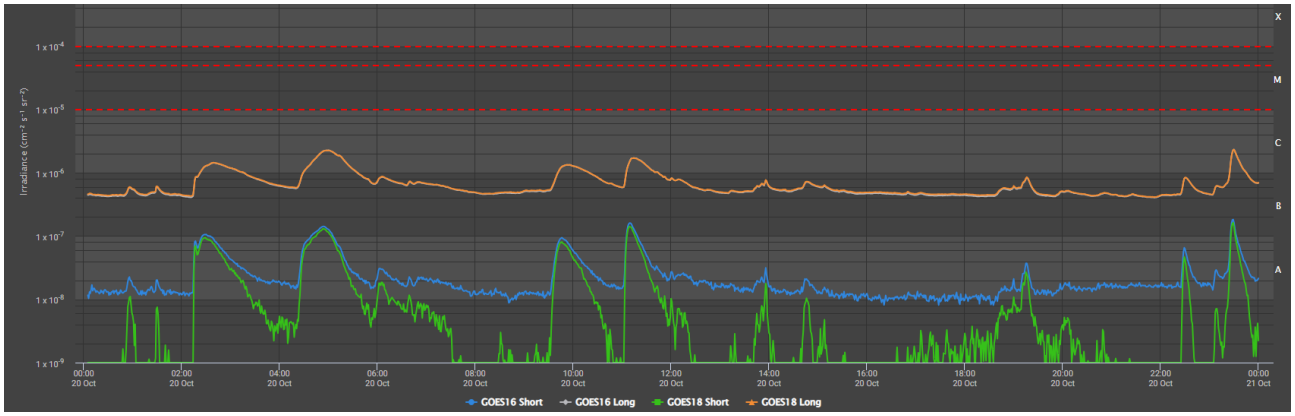
Radio Blackouts - X-Ray Flares:
There are currently six sunspot regions on the visible disc, all of which are relatively small and simple, with only AR3469 in the northwest showing some minor growth in recent hours.

Activity is likely to remain Low, with only C-class flares, in the absence of any significant development of the regions currently on the visible disc. There is just a slight chance of an isolated low level M-flare. However, towards the end of the period new or returning regions may rotate on from the far side, which is indicated in the slight increase in flare probabilities.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray trace at GOES 16 and 18, showing minor flares only.



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at background levels, due to the lack of significant regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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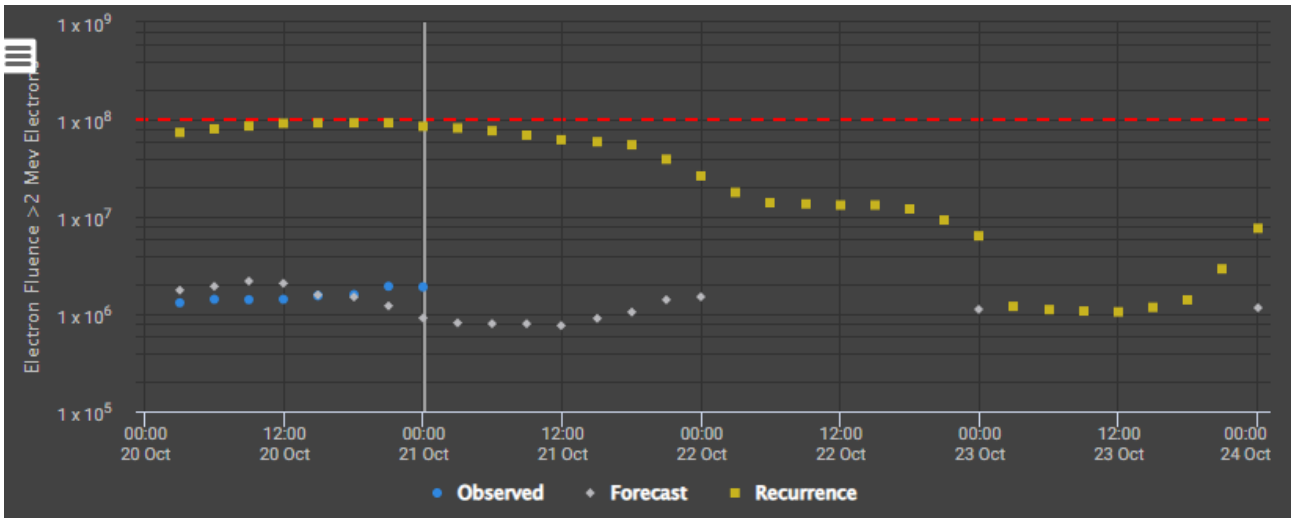
High Energy Electrons Event (≥ 2MeV):
Electron flux observed by GOES16 at GEO is currently background levels. Solar wind enhancements are possible through the coming days, with two possible weak CME arrivals, and also the potential for two weak HSSs. These are all low confidence however, and any enhancement is expected to be largely weak. Influence from these features could increase the electron flux in the Van Allen belts during the period, which could bring periods of moderate flux, most likely towards the end of the period.

The associated 24-hour fluence is expected to remain well below the Active threshold, as supported by MOSWOC REFM output. However, the model does not take into account any potential CME arrivals. Therefore, fluence levels may increase slightly towards the end of the forecast period, but this is low confidence.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a steady trend well below Active (1e8 integrated pfu).



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